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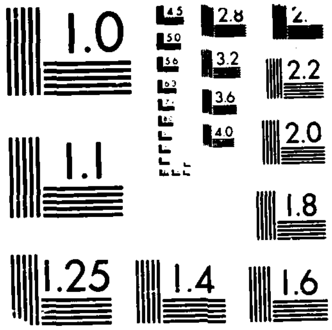

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TOPOGRAPHIC SUPPORT FOR THE ARMY IN THE FIELD

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ABSTRACT

The current state of topographic support to the Army in the field, which has changed little since World War II, is briefly discussed as an introduction to the major changes that are about to occur. Computer assisted techniques for the Corps and Division's terrain teams will be available when the Digital Topographic Support System (DTSS) is fielded. On the reproduction side, a new capability, which will go down to the division level, will cut the time to reproduce hardcopy from days or even weeks to minutes. Products will be produced which are currently impossible to produce. The system to do that, the Quick Response Multicolor Printer, will be fielded with the DTSS. In the future the AirLand Battlefield Environment demonstration program will result in a dramatic improvement in capabilities for the commander to use the environment to his/her advantage. All these initiatives are discussed. In summary, the Army is undergoing a topographic revolution.

INTRODUCTION

The current topographic support in the Army consists of two major parts. The terrain units provide special products for the commanders, and reproduction equipment provides hardcopy. Topographic support for every Army unit produces special products for the commander down to the division level. Until recently, the methods and tools used to provide this support changed little since World War II. The products were produced manually. Stacks of papers and graphic art materials, such as pens, drafting boards, templates and straight edges, comprised the staple materials available to the terrain units. A few would be lucky enough to have a programmable calculator, and if available, it was frequently the personal property of one of the members of the terrain team. The choice of products available was limited by what a human could reasonably be expected to produce given a definite timeframe in which to respond. One of the most desired classes of products, the intervisibility products, was rarely produced due to the time it took to produce them manually. For example, the full radial masked area plot, with each radial extending from the center of the circle showing the visible areas, would take a soldier up to 50 hours to produce by hand. All products had a slow turnaround. If a terrain team didn't anticipate which products would be required for an operation and produce them in advance, they could not provide

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the products in a meaningful timeframe in a tactical environment. Space and transport problems were considerable because the process was completely hardcopy based. The data base was a stack of paper or mylar, the output was paper or mylar, and several pieces of paper or mylar would be created in the process of producing the desired product. Each of these pieces of hardcopy had to be catalogued, stored and transported every time the unit moved. There was no such thing as a minor change to a product. If a product were too cluttered and some of the information, had to be removed, or if it was requested at a different scale, it had to be redrawn by hand. Basically, the manual process was not responsive to the commander's needs.

On the reproduction side of the picture, things were, if anything, even more bleak. Reproduction support was not available at division, it was only a corps asset. The lithographic process currently used in the field is virtually unchanged since World War II. It, however, is still an effective way to produce large quantities of hardcopy materials. But it takes time to prepare for the printing process starting with the reproducibles and if massive changes are required or the reproducibles are not available, it can take days or more likely weeks to complete the job. The requirements in the field for reproduction are particularly unsuited to the lithographic process. Ninety percent of the reproduction requests in the field are for twenty five copies or less so the one major advantage of the lithographic process, being able to produce quickly a large volume of copies, is not used. The requests also are needed very quickly and the ability to modify and enhance the standard map products is a requirement. The task of creating a new map from four existing maps is a difficult process. Making copies of a captured enemy document is a week-long process and is, therefore, rarely done in a battle situation.

GLIMPSE OF THE FUTURE

The change over to the new computer-aided environment actually began in the 70s when the U.S. Army Engineer Topographic Laboratories (USAETL) started producing a series of reports which documented the manual processes used by the terrain units to produce their products. While these were primarily meant as an interim guide for the terrain units, they became the essential building blocks which allowed USAETL to pursue a computer-based approach to terrain support for the commander. Without documentation of the manual methods, automation is extremely difficult, if not impossible. The scientists and engineers at USAETL assembled an automated capability in a laboratory environment which showed how quickly and flexibly topographic products could be produced using digital techniques. They then developed demonstration systems which could be taken to the field and used by the troops. These demonstrations showed the utility and effectiveness of USAETL's approach and gave valuable

information to USAETL on the required characteristics of a field system including every aspect of the man-machine interface.

The Army, during this time, made a special version of the Microfix for the terrain units. The Microfix is an Apple-II based system and provides a primitive level of computer support to the terrain units. It introduced the units to computers, and will help ease the way for the better things which are to come.

THE NEXT STEP

The next step in the process of modernizing the terrain support for the commander will be the fielding of the Digital Topographic Support System (DTSS) in 1992. The DTSS is currently under development. A contract was awarded in July 1987 for the full-scale engineering development. The Joint Tactical Fusion Program Office (JTFPO) is the program manager and they have appointed USAETL as the project manager for the Combat Terrain Information System (CTIS). There are two product managers under the PM-CTIS. One of these is PM-DTSS which also resides at USAETL.

The DTSS will use as much existing hardware as possible. This approach not only reduces costs but also minimizes program risk. The All-Source Analysis System (ASAS) Program is developing much of the hardware which will be used by the DTSS. The heart of the DTSS will be the Portable ASAS-ENSCE Work Station (PAWS). The PAWS hardware has been tempest approved and ruggedized. It is based on a MicroVax II computer with disk storage, color monitors and video-disk player. Two pieces of hardware will have to be developed for the DTSS program. These are the digitizing hardware and plotter. PM-ASAS has expressed interest in this hardware when DTSS has completed the ruggedization. The synergism of these developments has proven beneficial to both DTSS and ASAS. A second processor, additional mass storage, communications equipment, a 30KW generator and all the support hardware complete the DTSS hardware suite. The hardware will be configured in a standard Army shelter mounted on a standard Army 5-ton truck.

The DTSS contractor will have available the software generated by USAETL in its laboratory and during field demonstrations which further reduces program risk. All of the required products specified by the user proponent, the U.S. Army Engineer School, will be available in the baseline system. In addition, the terrain analyst will be able to use the system to create special products tailored to the specific needs of his/her commander. Anything that a terrain analyst knows how to do manually can be done on the DTSS in a fraction of the time. Although, terrain analysts know how to produce a particular product, in the past the product would not be produced due to the time and effort involved. With the DTSS these products can be produced swiftly. A great deal

of attention is being devoted to the man machine interface to ensure the current terrain analysts will be able to use the DTSS effectively. The knowledge gained during USAETL's field demonstrations will ensure the DTSS will be effective when it is fielded.

Due to the critical need for the DTSS, it is a fast track program and although the contract was only awarded in July 1987, testing will begin in 1989. Some of the other key characteristics of the DTSS are the availability of digital products in addition to hardcopy output, and the capability to enhance and update the Defense Mapping Agency's digital data bases.

The reproduction side of topographic support is in for an even greater upgrade. For one thing, the new capability will exist at division where none currently exists. Secondly, it will provide products that would currently take days or weeks, if they could be provided at all, in less than six minutes with additional copies being produced at the rate of one per minute. The system that will do this and more, is the Quick Response Multicolor Printer (QRMP). The program management structure is the same as for the DTSS and as in the case of the DTSS, USAETL has been appointed product manager for the QRMP.

The QRMP will be fielded at division, corps, and echelons above corps. At division the QRMP will be co-located with the terrain team and, therefore, the DTSS. One of the many exciting features of the QRMP is its capability to accept digital input as well as being able to copy from hardcopy input. It will produce products directly from the DTSS and print full-size hardcopies at the rate of 60 copies per hour. The QRMP is capable of copying full map-size products (22.5" by 29.5"), in full color with the required resolution.

The QRMP system consists of a ruggedized QRMP in a standard Army shelter, on a standard Army 5-ton truck, with a 30KW generator and all required supporting hardware. Typical hardcopy inputs include standard maps, maps with color notation, maps with clear overlays, ground and aerial photography, typed or printed materials, and composite products consisting of paste-ups of any of the above listed inputs.

The Required Operational Capability (ROC) has been approved and the Milestone II In-Process Review has been held. Award of the Full-Scale Engineering Design contract is expected by January 1988. QRMP will make a major dramatic impact on field reproduction capability for the Army. It will produce special products including composite products in a matter of minutes, it will accept digital input, it will provide the quick turnaround low-volume reproduction capability which is what actually is needed by the Army and it will provide that capability at division. It will do all of that while significantly reducing a battlefield signature and personnel requirements.

Together the QRMP and DTSS will revolutionize the way the Army provides topographic support to the commanders. These systems will give the commander the edge he needs on todays lethal battlefield.

A LOOK INTO THE FUTURE

While the DTSS and QRMP are major steps in helping the commander deal with today's and tomorrow's battlefield, more can and must be done. The AirLand Battlefield Environment (ALBE) demonstration program has been formulated by the Corps of Engineers to provide the edge the commander will need. It addresses more than just the terrain and will encompasses every aspect of the battlefield environment including terrain, atmosphere, weather, climate, background signatures, battlefield induced contaminants and natural obscurants. The ALBE demonstration program is a way to transition products out of the tech base of the labs involved and into the field. The labs currently participating in the program are the Engineer Topographic Laboratories, the Waterways Experiment Station, the Atmospheric Sciences Lab (an Army Materiel Command Laboratory) and the Cold Regions Research and Engineering Laboratory. ALBE has chosen an innovative way to transition its capabilities into the field. ALBE will never field a system, rather it will use systems either currently fielded or under development as the hardware vehicles. A prime target system is the DTSS. While DTSS will have some capabilities in some of the ALBE software categories, the ALBE software represents significant new and enhanced capabilities.

The ALBE test bed hardware consists of two parts, each mounted in an Integrated Command Post shelter on a Commercial Utility Cargo Vehicle (CUCV). Each part has a MicroVax II, storage, displays and plotters. One part is the terrain processor, and the other is the weather processor. They are fully linked so that data and products can be shared. In addition, to the common hardware, the terrain processor has a digitizer and charged coupled device digitizing camera, while the weather processor has a full suite of environmental sensors.

The ALBE demonstration program will be a continuing way to transition capabilities from tech base to the field. Block I, scheduled to end in 1990 will have extensive product generation capabilities for Ground Mobility, Countermobility, Nuclear, Biological, and Chemical Warfare, Weapons System Performance and a full range of terrain and atmospheric utilities.

The Ground Mobility Software produces a wide range of products concerned with the ability to predict the performance of single vehicles or convoys of vehicles, either friendly or threat on any type of terrain or road under any weather conditions. The user can generate the mobility products, utilizing current actual weather conditions, forecast conditions or any other weather conditions at his/her choosing. The products can, therefore, be used in battle decision making, prebattle planning,

in exercises or in "what-if" scenarios. In addition, to performance models, reasons maps are available. These are products which show the commander why the mobility is limited in a particular area. Many innovative presentations are available, from telling the user how fast he/she can go in a particular area for a particular vehicle to how far one can travel in a given time starting at a point and going in any direction.

The countermobility software predicts the effectiveness of obstacles both in terms of how effectively the obstacles can be deployed and once they are deployed, how effective they are in hindering mobility. Obstacles that will be addressed include, mines, wire, craters, rubble, ditches, logs, and flood zones. The products will help the commander decide where each obstacle will be effective and, using these products, the commander and his/her staff can reduce the time required to implement an integrated obstacle system. All-weather conditions can be considered including extremely wet conditions, snow cover and frozen soil.

The Nuclear, Biological, and Chemical Warfare software generates products which will give the extent and persistence of NBC hazards and smokes, the side effects (especially heat exhaustion) of chemical protective clothing, and guidance regarding the decontamination of materiel on the winter battlefield. The software will provide the capability to display the extent of nuclear fallout areas, chemical hazard areas and smoke screen areas in two or three dimensions.

Weapon Systems Performance software models the effectiveness of electro-optical and seismic/acoustic sensors and systems. One of the products computes both the detection and recognition ranges for a specified combination of sensor types and target type. This product takes into consideration the background signature and current or specified atmospheric conditions. Other products include those that predict hours of utility for night vision equipment and comparison of different sensors effectiveness given target background types.

The final category of applications software is the terrain and atmospheric utilities. While these provide products of interest to the commander, they also provide products which are used by the other ALBE software modules. The subcategories in this area are intervisibility, sensor communications and data handling, weather effects messages, surface and upper air data, military hydrology, target area winds, and three-dimensional perspective view. The sensor communications and data handling and surface and upper air data software is of vital importance because this is the software that monitors the environmental sensors and then reformats the data for use by all of the applications software. The military hydrology software forecasts water stage and water flow for any specified drainage areas taking into consideration the watershed and precipitation. Target area winds compute the speed and direction of ground- and upper-level

winds taking into account the influence of the terrain. This is especially important in all denied areas where there is no sensor information available. This software will also produce a more accurate interpolation of wind conditions in those areas where sensors are available. The three-dimensional perspective view will allow any ALBE product or combination of products to be overlayed on the terrain and displayed. The weather effects messages warn of potential impacts due to critical values being reached. The intervisibility software is a large set of products, all dealing with the effect of the terrain and vegetation on the line of sight between two points.

One of the keys of ALBE is integration, both in the sense of integrating several products into one product that would serve as a tactical decision aid for the commander and his/her staff and in the sense of integrating the effects of the many components of the environment. Initially, the product integration capability basically will be overlaying products, then increased to include the user capability to delete or highlight information while forming a composite product. Finally, the goal is for an artificial intelligence approach to automatically generate a command graphic from individual products based on a given scenario.

One of the other interesting features of ALBE is the implementation of a new geographic information system (GIS) which will enhance the state of the art in this area. The basic system will have a standard GIS; however, by 1989, a new integrated GIS will be available which makes the internal data structure and data types invisible to the applications programmer.

The ALBE demonstration program is actually much more than a demonstration program because the test bed will undergo formal evaluations. There will be three evaluations for Block I of ALBE. These will be held in December 1987, March 1989 and July 1990. The evaluations are being performed as part of the Army Tactical Command and Control System (ATCCS) Experimentation Site (AES). The AES will have either a copy or a surrogate for every system which comprises the ATCCS. It will, therefore, provide an excellent opportunity to identify experimentally which systems need ALBE products and help identify which systems are potential transfer targets for ALBE software. The evaluations will be performed by the 9th Infantry Division with the Combat Development Experimentation Center (CDEC) and Board acting as the tester. The evaluator will be the Command Control Communication and Intelligence Division of Army Development and Employment Agency (ADEA). The first independent evaluation report will be available May 1988. In addition, ALBE might participate in formal exercises with other troop units.

SUMMARY

Topographic Support for the Army is undergoing significant changes. By the early 90s the two components of

the Combat Terrain Information System, the Digital Topographic Support System and the Quick Response Multicolor Printer, will be fielded. Throughout the rest of the 90s and into the next century, ALBE will serve as a vehicle for transferring the innovative technology being developed in several key Army laboratories to the Army in the field. Exciting changes are occuring which will greatly enhance the commanders ability to fight effectively. The Army is undergoing a topographic revolution.

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